Cascades: triggered data/MC disagreements

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Calibration phone meeting 06/10/2008

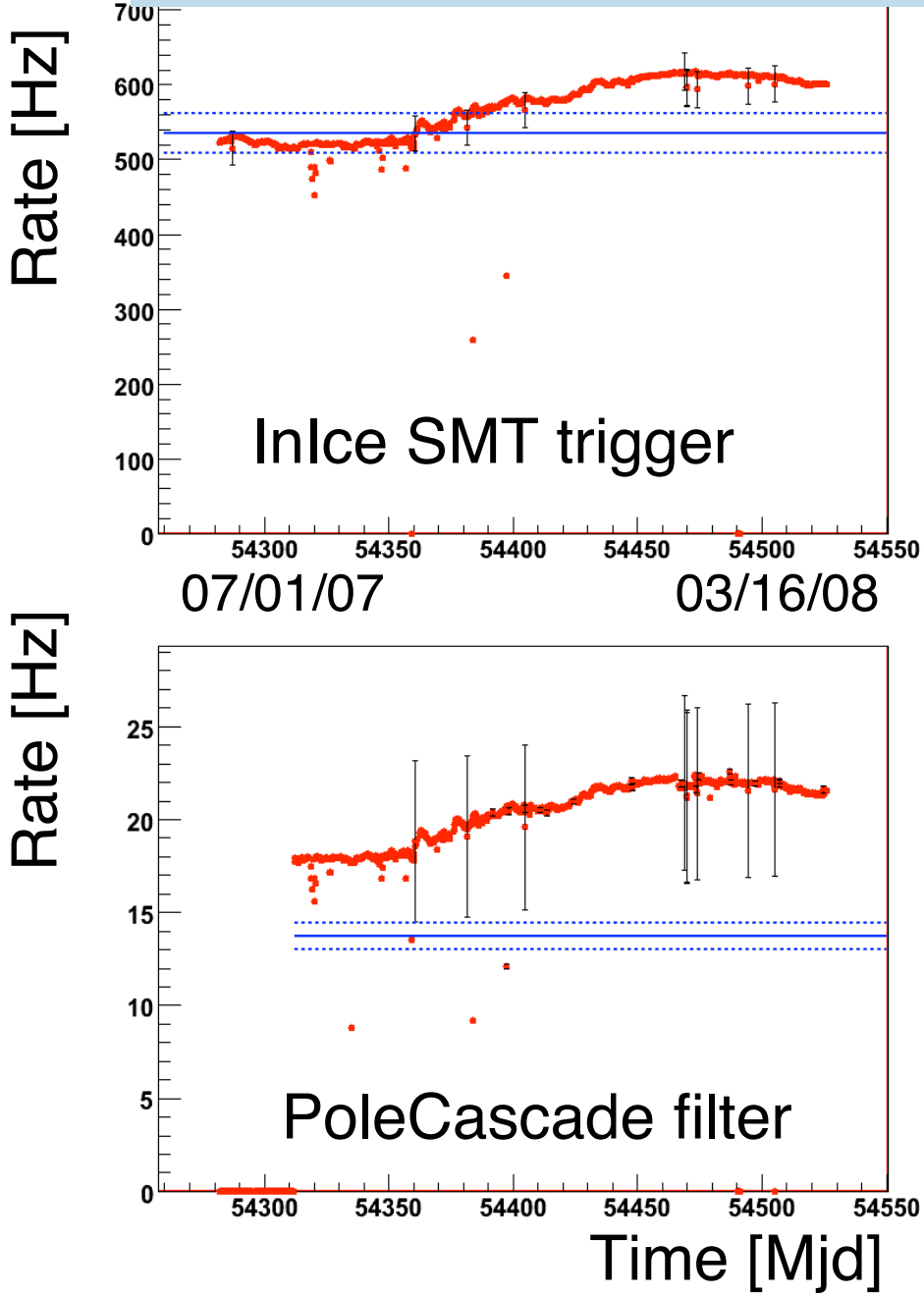
Selection of slides presented at the collaboration meeting
April, 2008 Madison

MC data used (2007 AHA photon tables)

1. Background MC (*7h livetime*)
   - Corsika (single muon) dataset 763
   - Corsika (coincident muon) dataset 861

2. Signal: only <u>electron</u> neutrino:
   - NuGen, E_ν^{-2} spectrum, $\log_{10}(E_\nu)$= 1.7 - 9.0
   - dataset 762: *50M generated, 0.34M triggered events*

IC22 Trigger and Pole Cascade Filter rates



Experimental rates from Monitoring page,
Run list from A. Goldschmidt

- Trigger rate: temperature variation

Data: 515 Hz to 615 Hz

MC: 535 Hz

- CascadeFilter rate:

Data: 18 Hz to 22 Hz

MC: 13.7 Hz

→ Data/MC > 50% disagreement

- CascadeFilter/Trigger rate ratio:

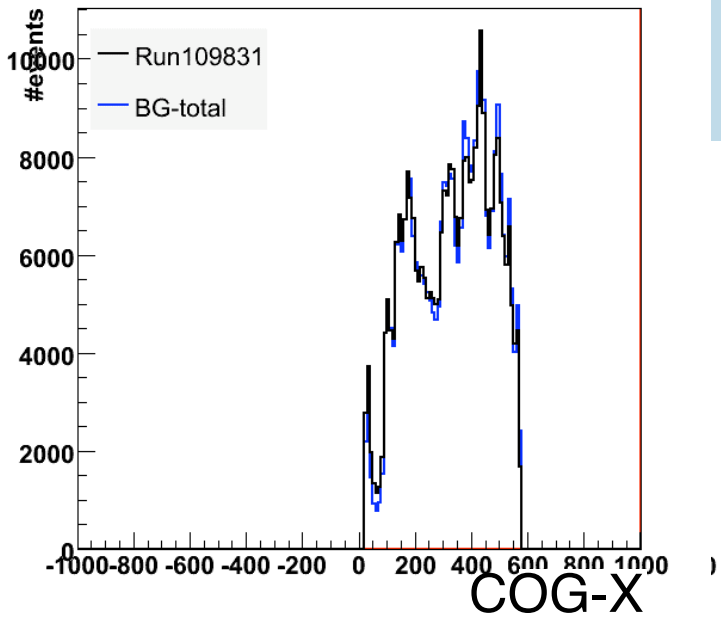
Data: 0.032-0.036 (stable)

MC: 0.026

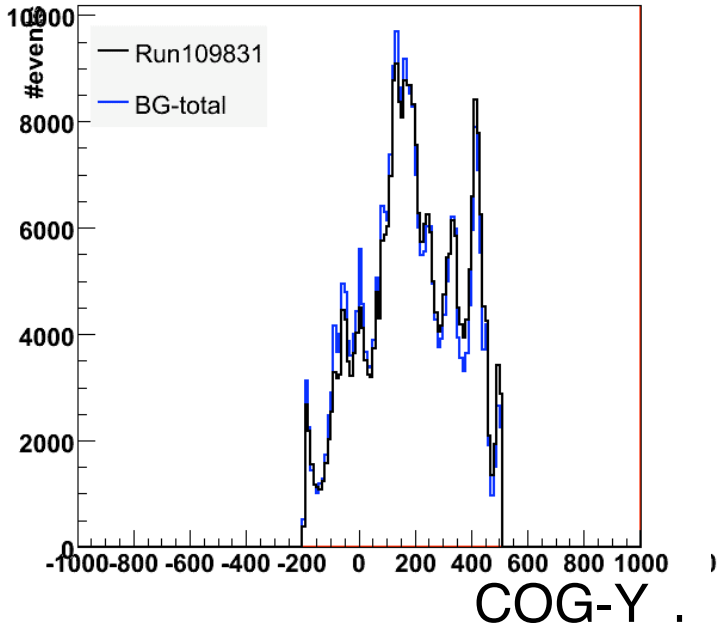
(MC_signal: 0.71)

IC22 Cascade Filter Level2 and Level3 events
Data vs MC comparison

IC22 Cascade Filter Level2: Data vs MC



COG-X

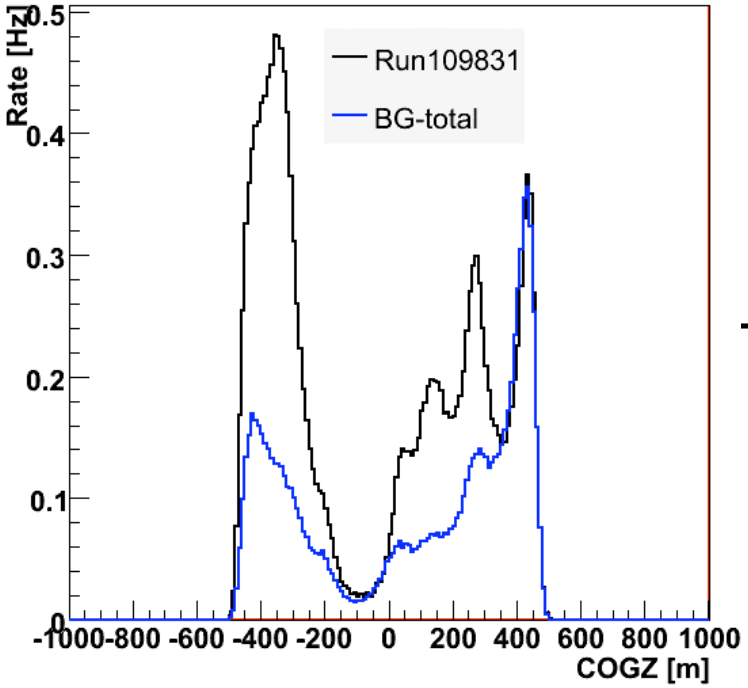


COG-Y .

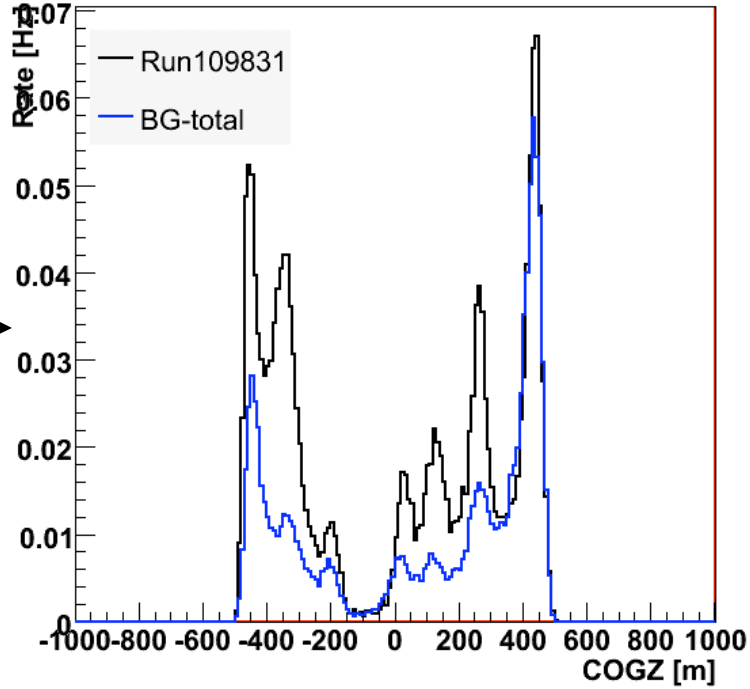
- Shape of COG-X and -Y: data well described by MC

IC22 Data vs MC: Level2 and Level3 (1)

Cascade Filter (Level2)



After Level3 cuts*)

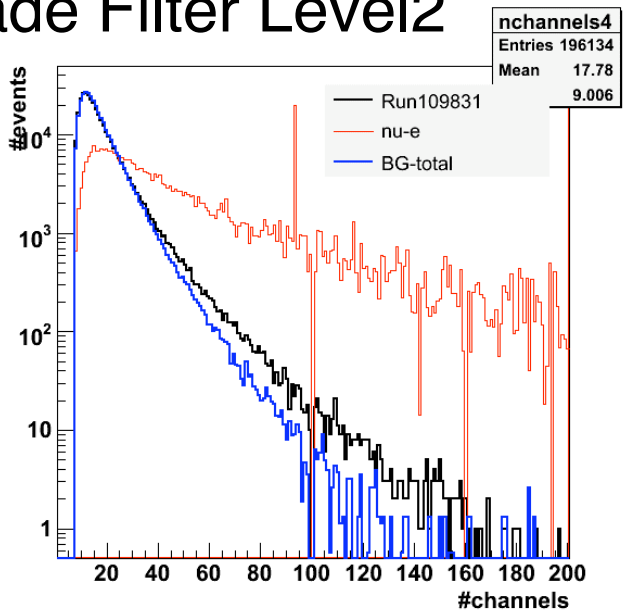


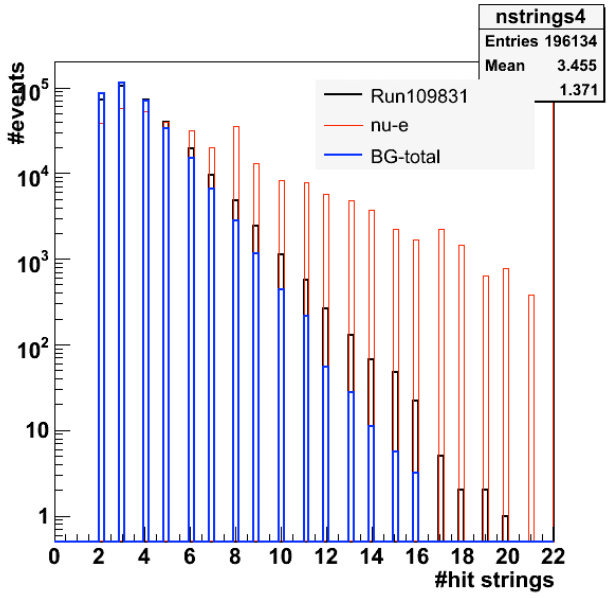
Improvement in Rate vs COGZ between data and MC after Level3 cut, but still a problem

*) level3 cuts: TrackLlh_Zenith>1.4 rad && RllhTrack/RllhCscd >1

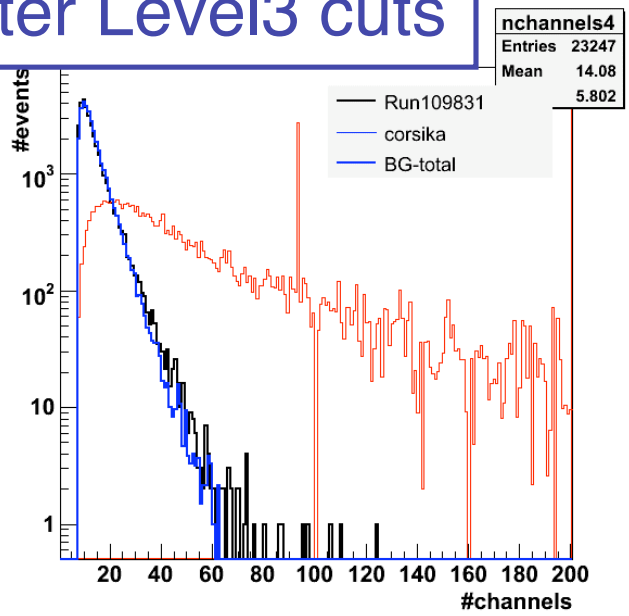
IC22 Data vs MC: Level2 and Level3 (2)

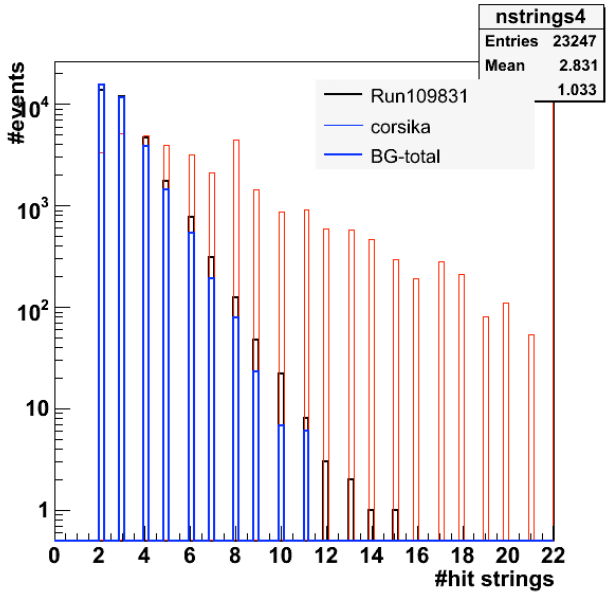
Cascade Filter Level2





After Level3 cuts



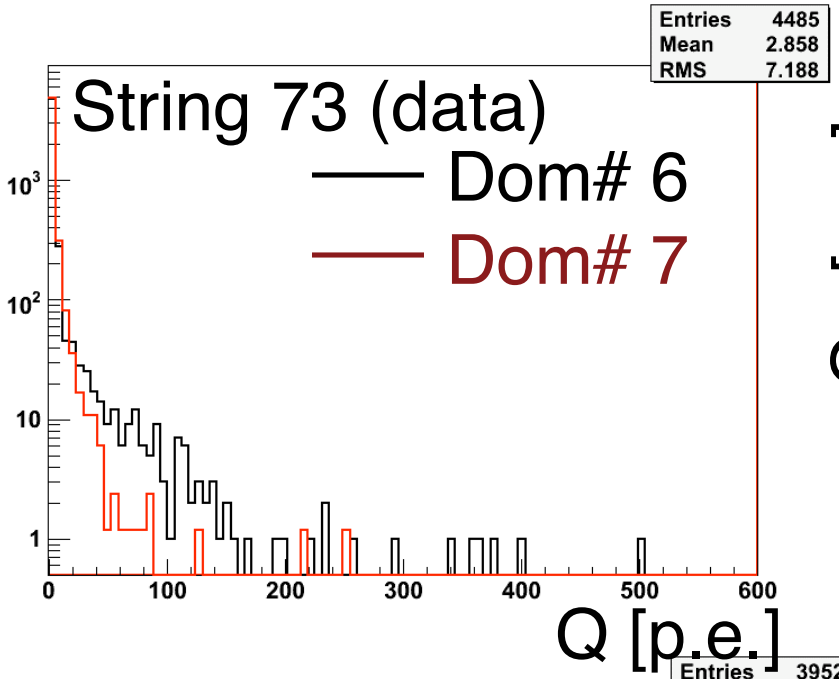


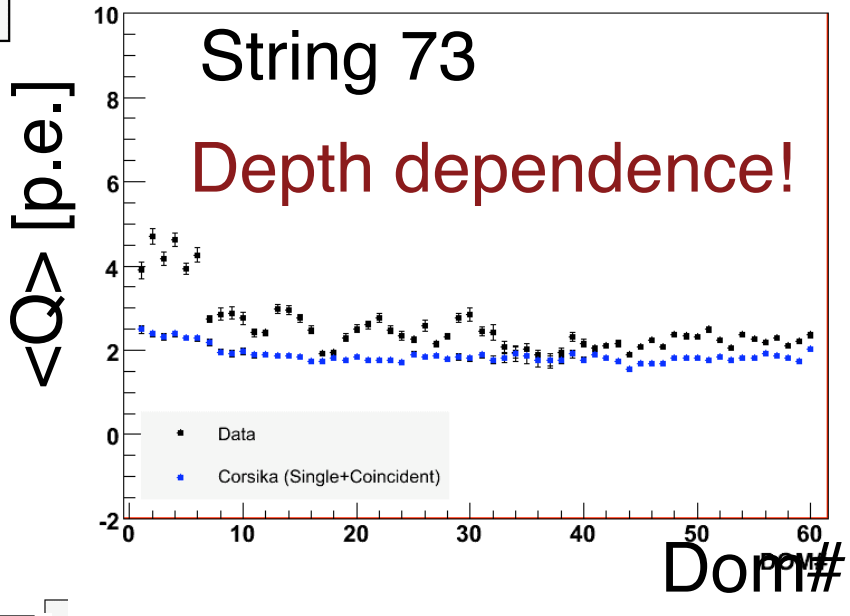
Improvement between data and MC after Level3 cut

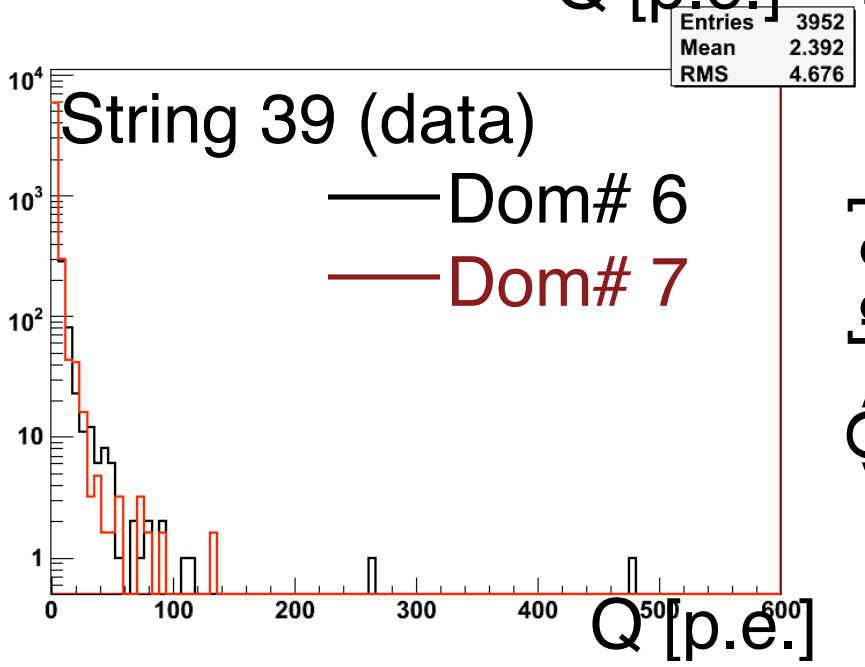
IC22 Cascade Filter events (level2) :

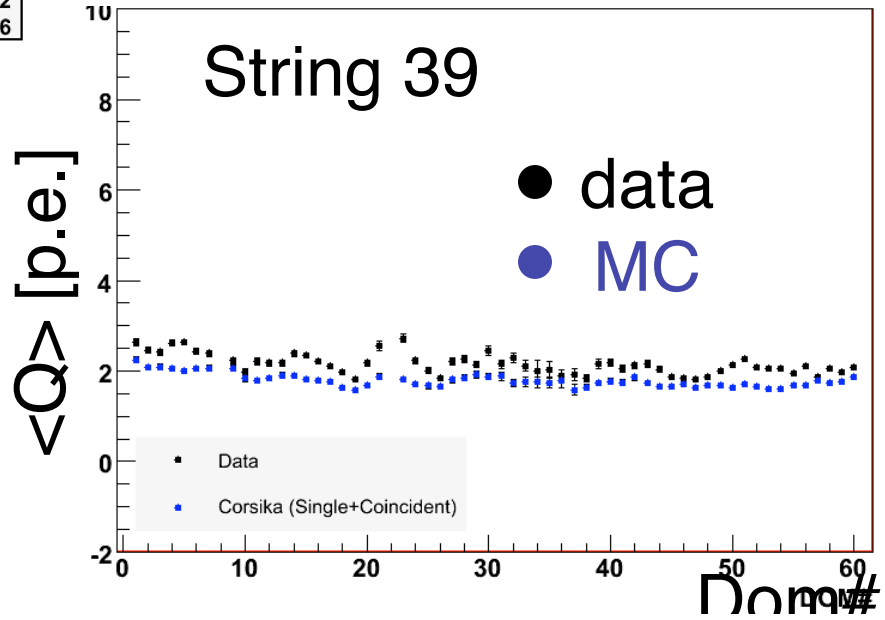
MC does not simulate properly a small fraction (a few per cent) of events with large charge near top of the detector

IC22 Cascade Filter Level2: Total charge per Dom vs depth





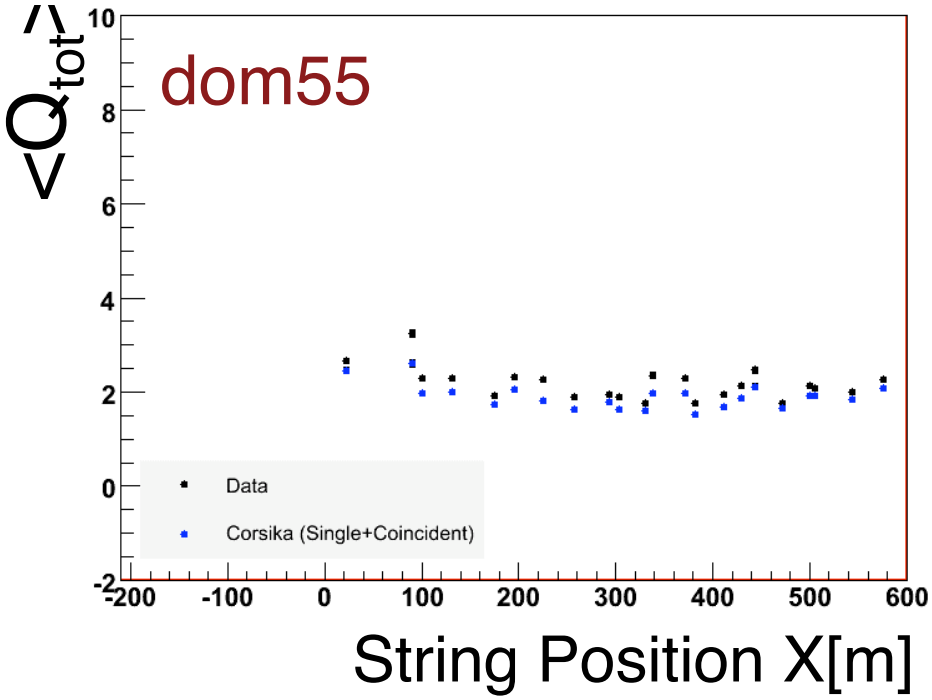


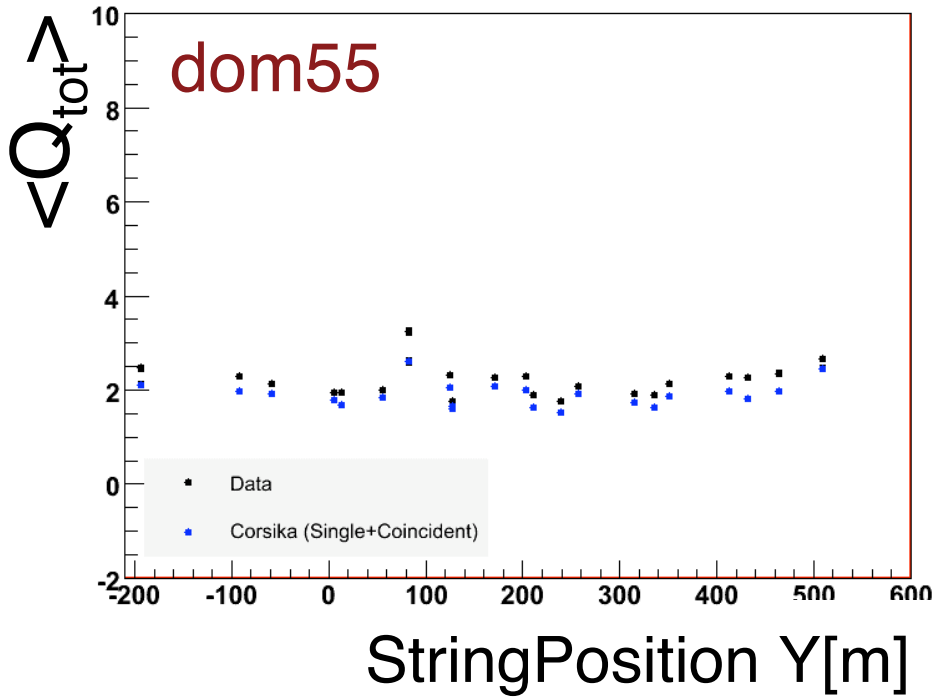


IC22 Cascade Filter Level2:

Total charge/Dom vs String X(Y)-position

(Fixed depth: i.e. take out the possible effect of ice layers)

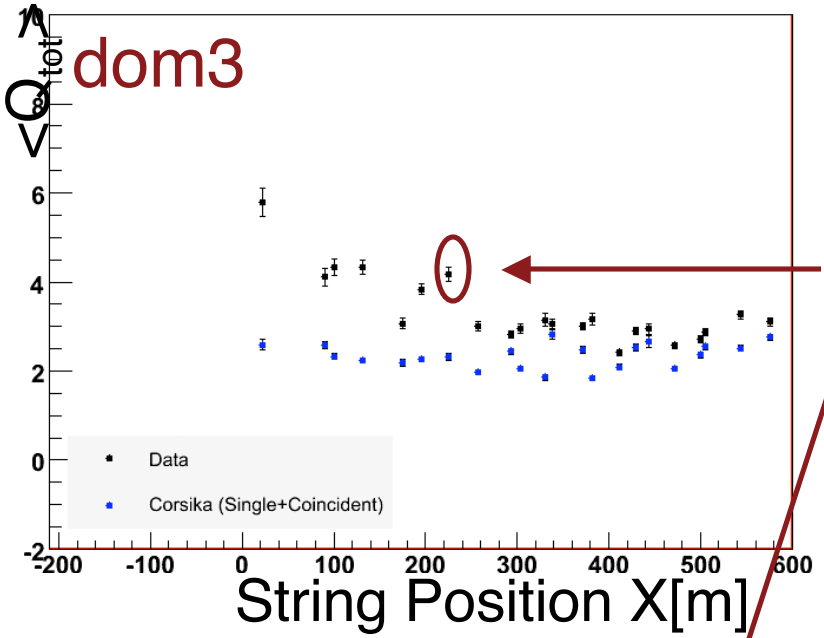




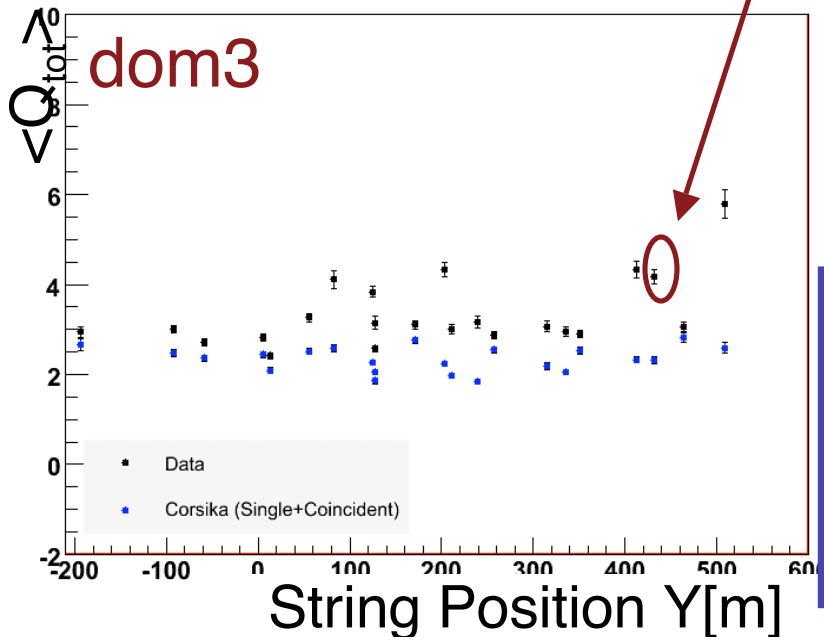
Good agreement between data and MC for DOM#55 (all strings)

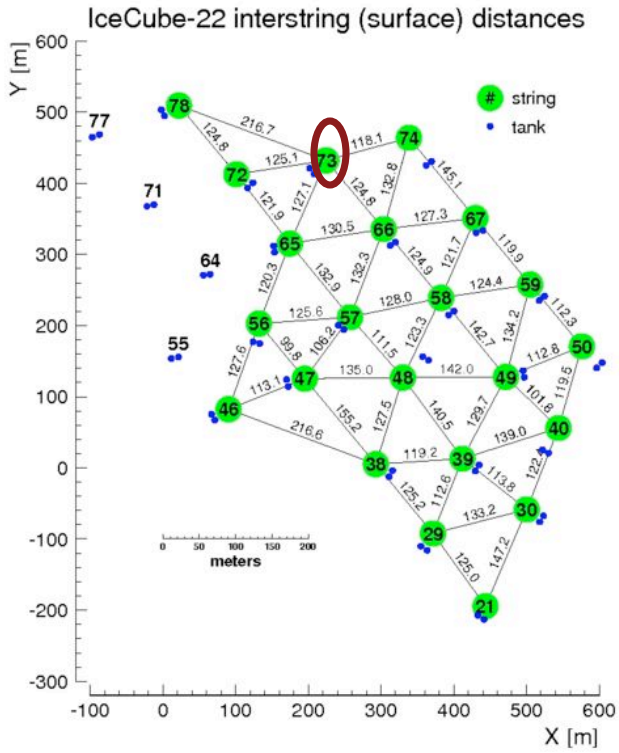
CascadeFilter Level2: Total charge/Dom vs Dom X(Y)-positior

i.e. take out the possible effect of ice layers (fixed depth)



string73





- Discrepancy between data and MC
- Problem caused by small fraction of events with large charge. Effect more pronounced at the top of IC22

Summary:

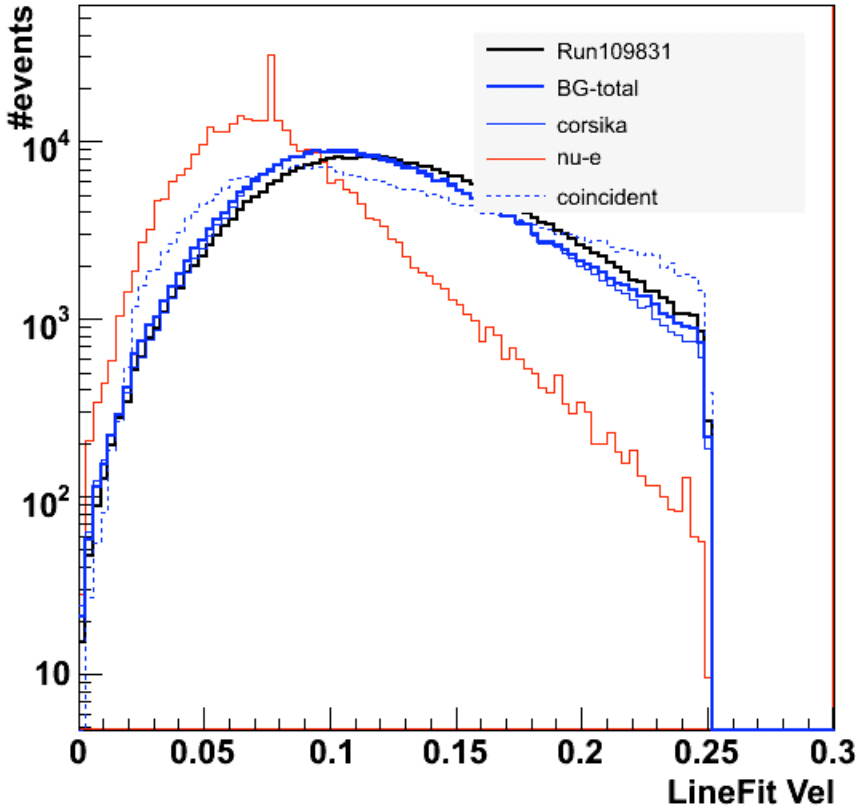
-CascadeFilter Level2: diagreement between data and MC (#strings, #channels, cascade filter rates)

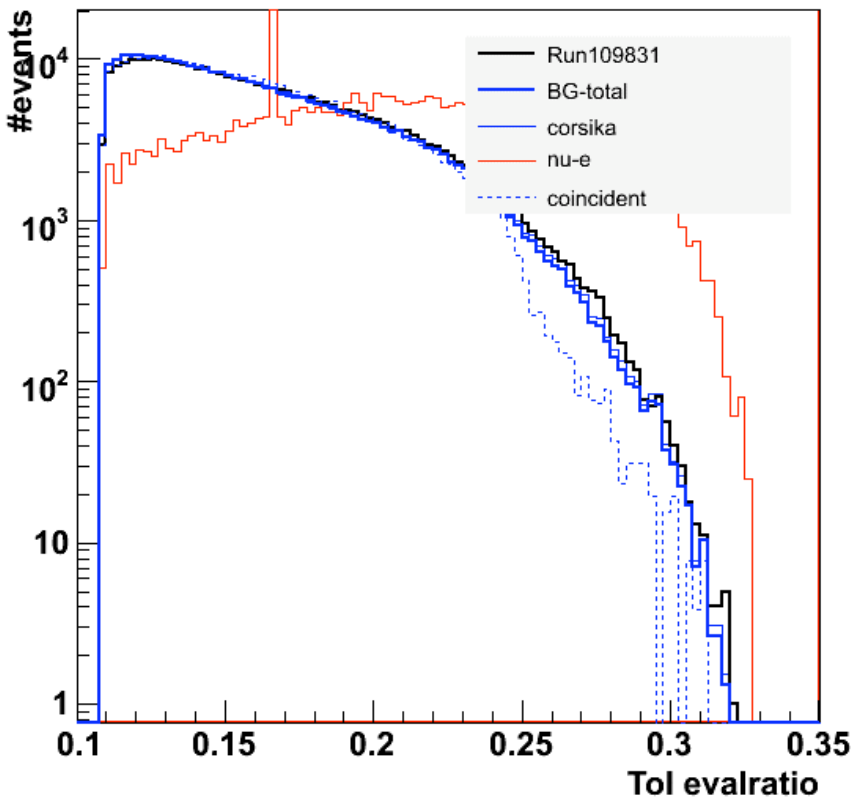
-Cascade Filter Level3 cuts ($N_{bg}/N_{sig} = 18 \times 10^3$) improve data/mc disagreement, more sophisticated cuts are needed.

-Small fraction of events with (cascade filter Level2) large charge near top of the detector is not described by current MC simulations.

BACKUP

IC22 Cascade Filter Level2: Data vs MC (1)





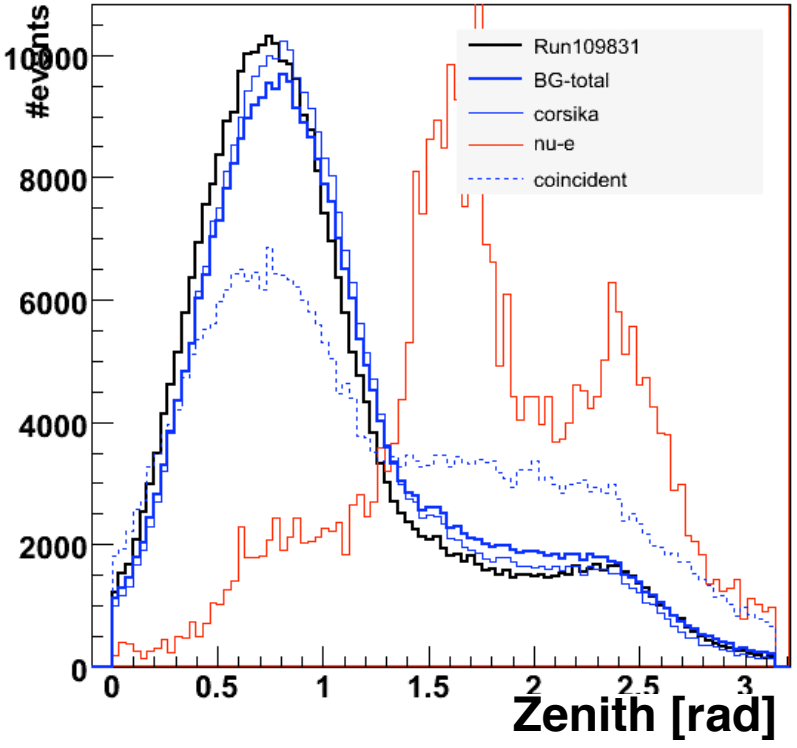
Cuts used in CascadePole Filter (P. Toale && M. D'Agostino)

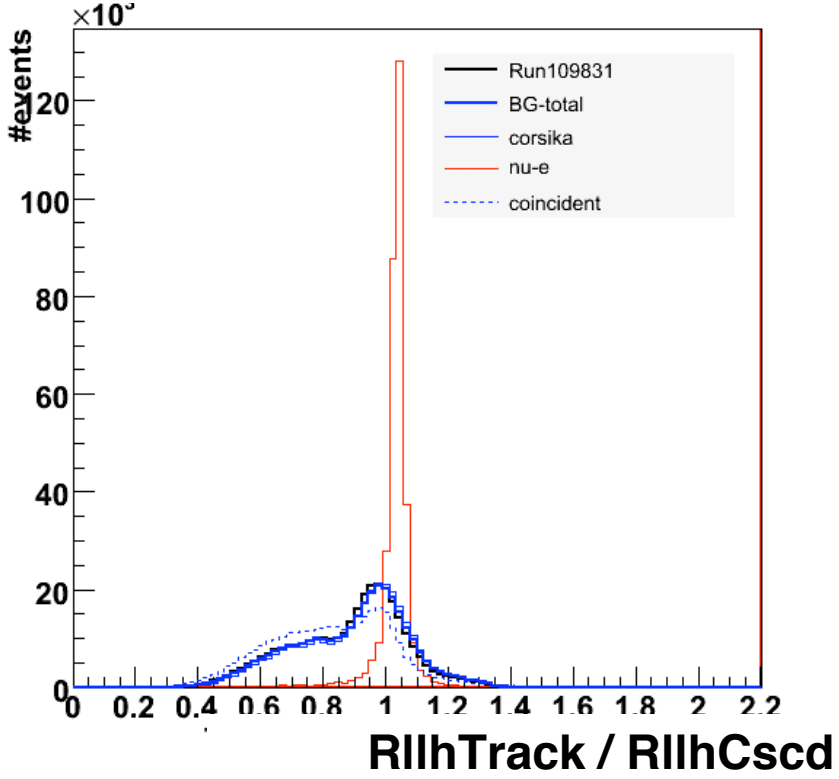
- *LineFit Velocity < 0.25*
- *Tensor of Inertia Evalratio > 0.109*

Backup:
Level3 cut definition

Cascade Filter Level2: Data vs MC (5)

- Reconstruction results from TrackLlh and CscdLlh algorithms

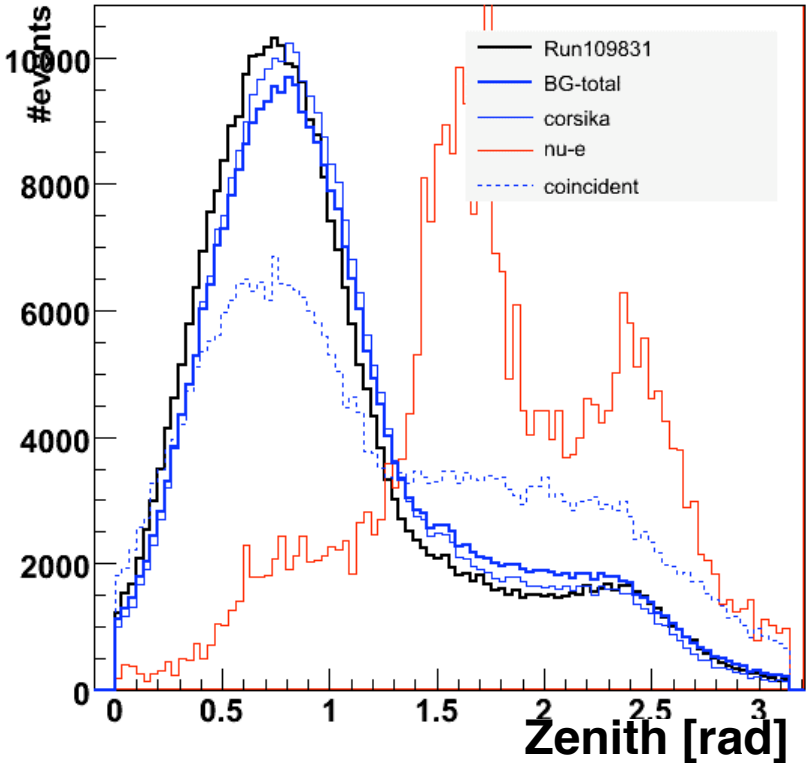


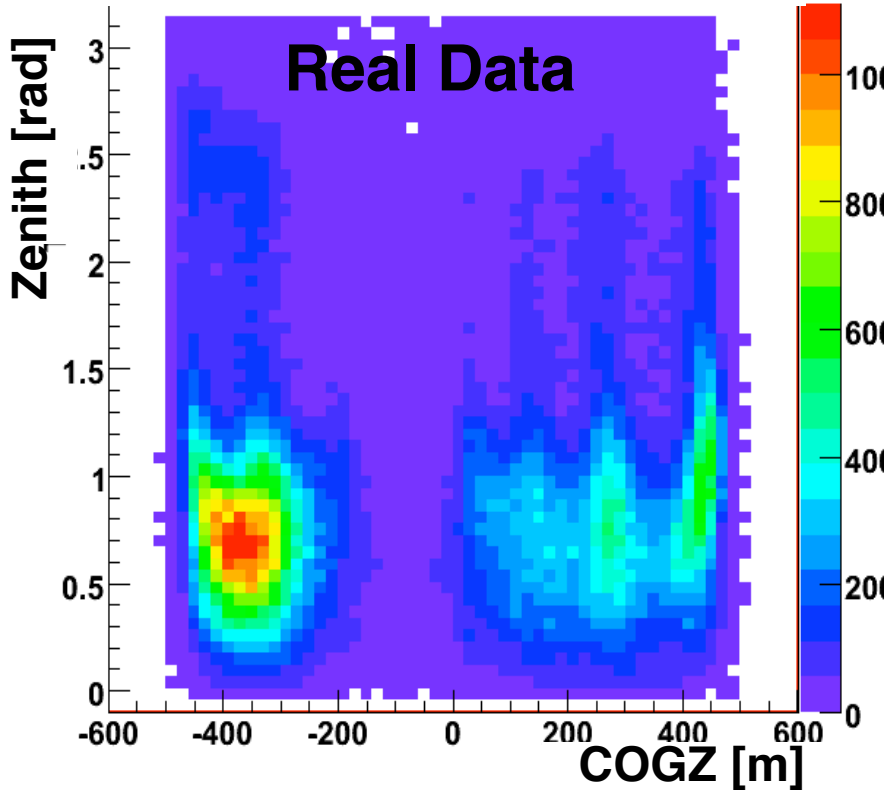


- Corsika (single muons): Events with Zenith>1.4 rad are misreconstructed downgoing “leading” muons

- Data: Excess of ‘cascade-like’ events with small values of reconstructed Zenith angle and small values of RllhTrack/RllhCscd are for COGZ at the bottom of IC22

Reconstruction Results at Level2
TrackLlh algorithm: reconstructed Zenith (Data vs MC)

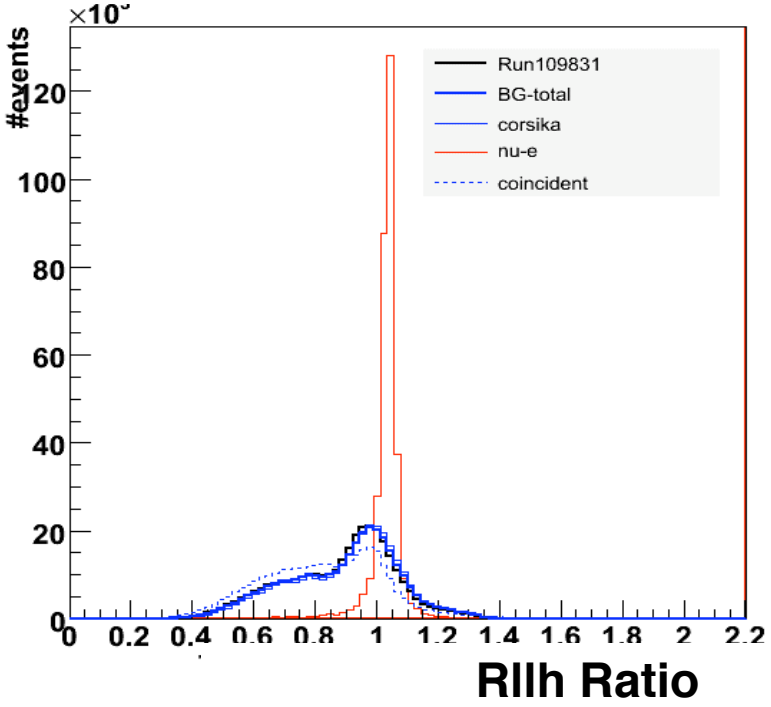


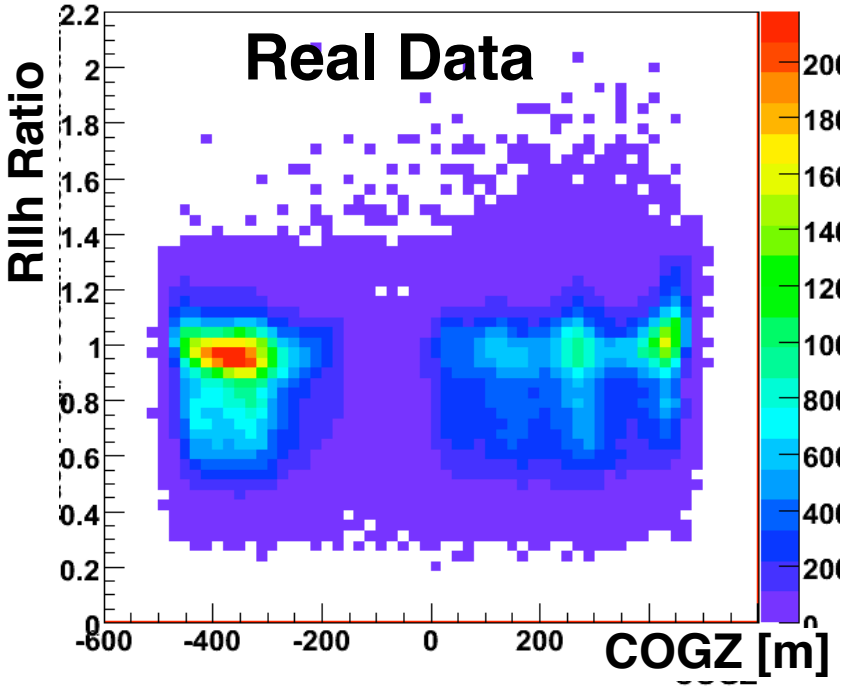


Interpretation from Corsika (single muon): Events with Zenith>1.4 rad are misreconstructed downgoing “leading” muons

Real data: excess of ‘cascade-like’ events with small values of reconstructed Zenith angle are at the bottom of the detector

Reconstruction Results at Level2
CscdLlh algorithm: RllhTrack/RllhCscd (Data vs MC)

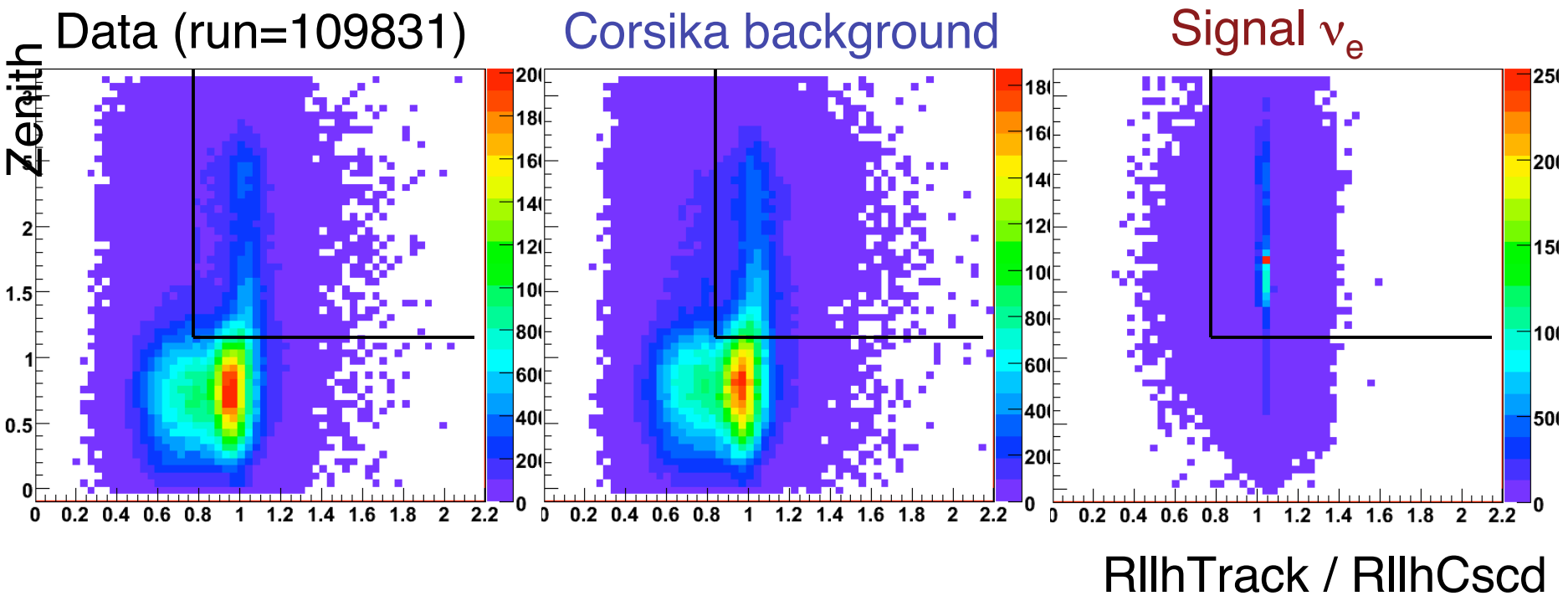




Real data: excess of ‘cascade-like’ events with small values of RllhTrack/RllhCscd are at the bottom of the detector

Level3 Cuts: Reconstruction Results at Level2

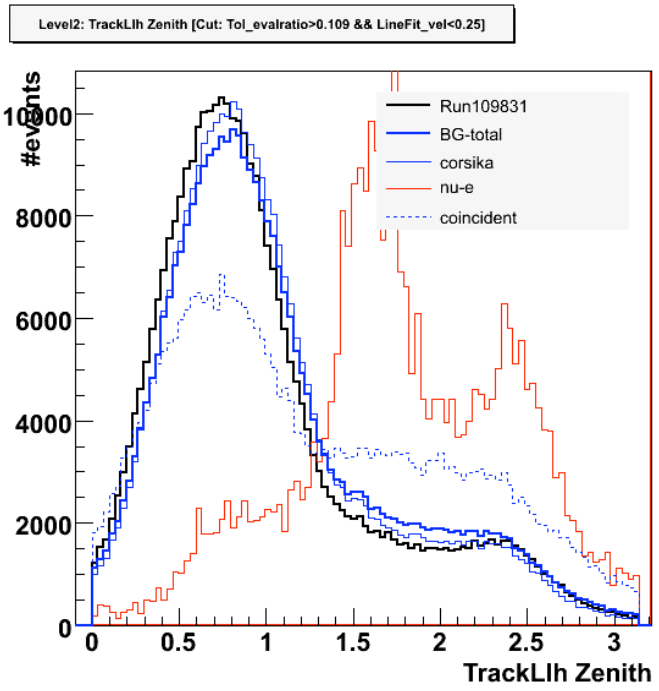
- TrackLlh Zenith vs RllhTrack/RllhCscd



Proposed cut for Level3 processing (common for all cascade analyses):

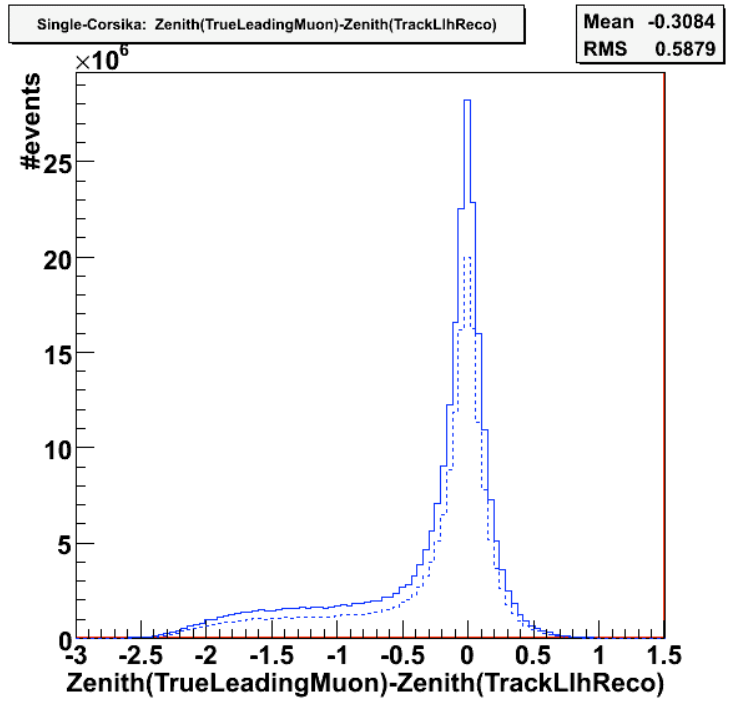
Zenith > 1.2 and RllTrack / RllhCscd > 0.8

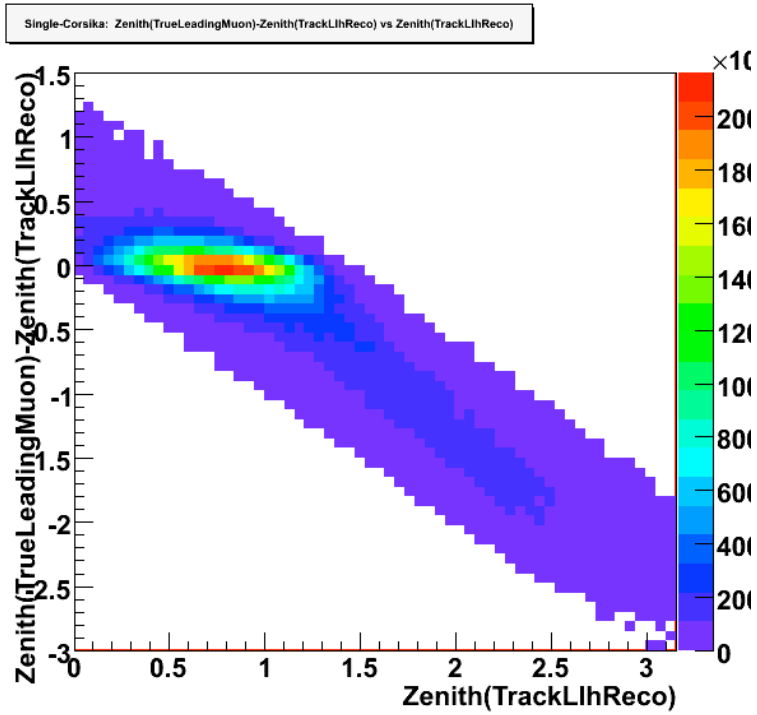
This cut is not optimal for individual analyses but seems to have acceptable bg rejection factor and signal passing rates for both extraterrestrial and atmospheric cascades analyses.



- Zenith>1rad for (Single) Corsika: Misreconstructed downgoing muons

Lesson learned from Muon-group
Potential with 32-iteration track reconstruction (CPU consuming)
To better reconstruct direction and Make cut on Zenith more effcient

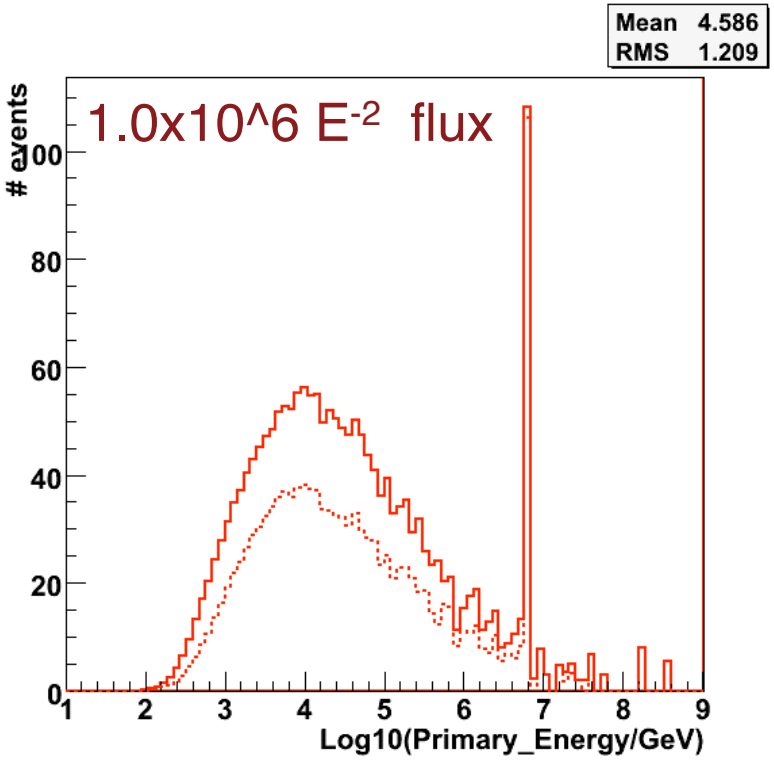


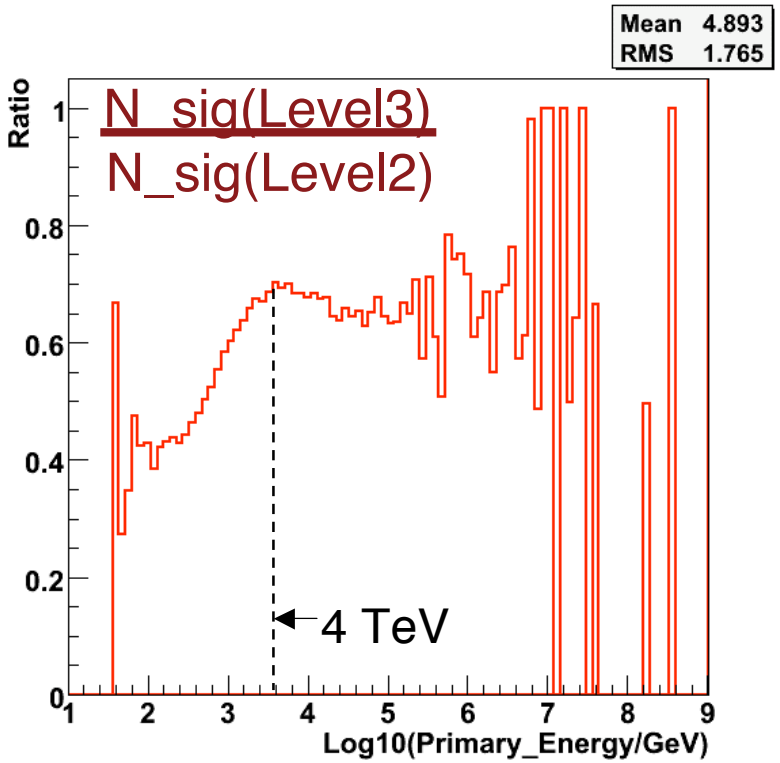


Extraterrestrial ν_e: Level3 Cuts Optimalisation

First try (not final method): Find the best combination of cuts on Zenith and RllhTrack/RllhCscd by minimizing sqrt(N_bg)/N_sig (using Monte Carlo only) assuming 240 days of livetime and signal flux(es) = 1.0 x $10^{-6(7)}$ E^{-2} .

Result: Level3 cut = Zenith> 1.4 rad && RllhTrack/RllhCscd > 1.0





Cascade Filter Level2: **First hit** charge per Dom vs depth